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H04Q 7/34, H04B 17/00

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H4L LFMA

(56) Documents Cited

EP 0565229 A JP 100183950 A JP 090135203 A  
JP 060311078 A JP 050061789 A US 5802039 A  
US 5640684 A US 5539803 A

(58) Field of Search

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INT CL<sup>7</sup> H04B 17/00, H04L 1/20, H04M 1/72, H04Q  
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ONLINE: WPI, EPODOC, JAPIO

(54) Abstract Title

Displaying the probability of attaining successful communication in a mobile radio terminal

(57) Terminal and method to display the probability of attaining successful communication in a mobile radio terminal, preferably a mobile radio telephone. The terminal has interference level detector means to detect a data error rate of a received signal and display means to display information concerning the detected data error rate, e.g. received signal interference level B. Preferably, the display means may simultaneously display information concerning other detected parameters affecting a probability of attaining successful communication, such as a received signal strength indicator (RSSI) A. Thus the display is able to provide a clear indication of the probability of successful communication method and the individual factors involved. The information may show low, medium or high probability of success (figs 1-3) and be displayed using a variable indicator such as a digit, icon, graph or bar or similar means.

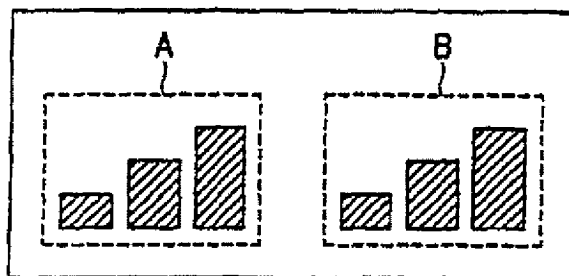


FIG. 5

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1995

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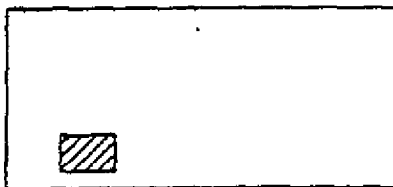


FIG. 1

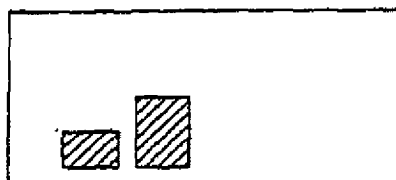


FIG. 2

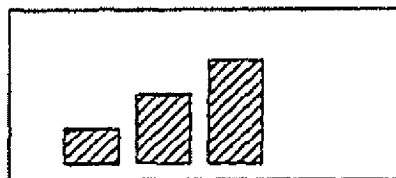


FIG. 3

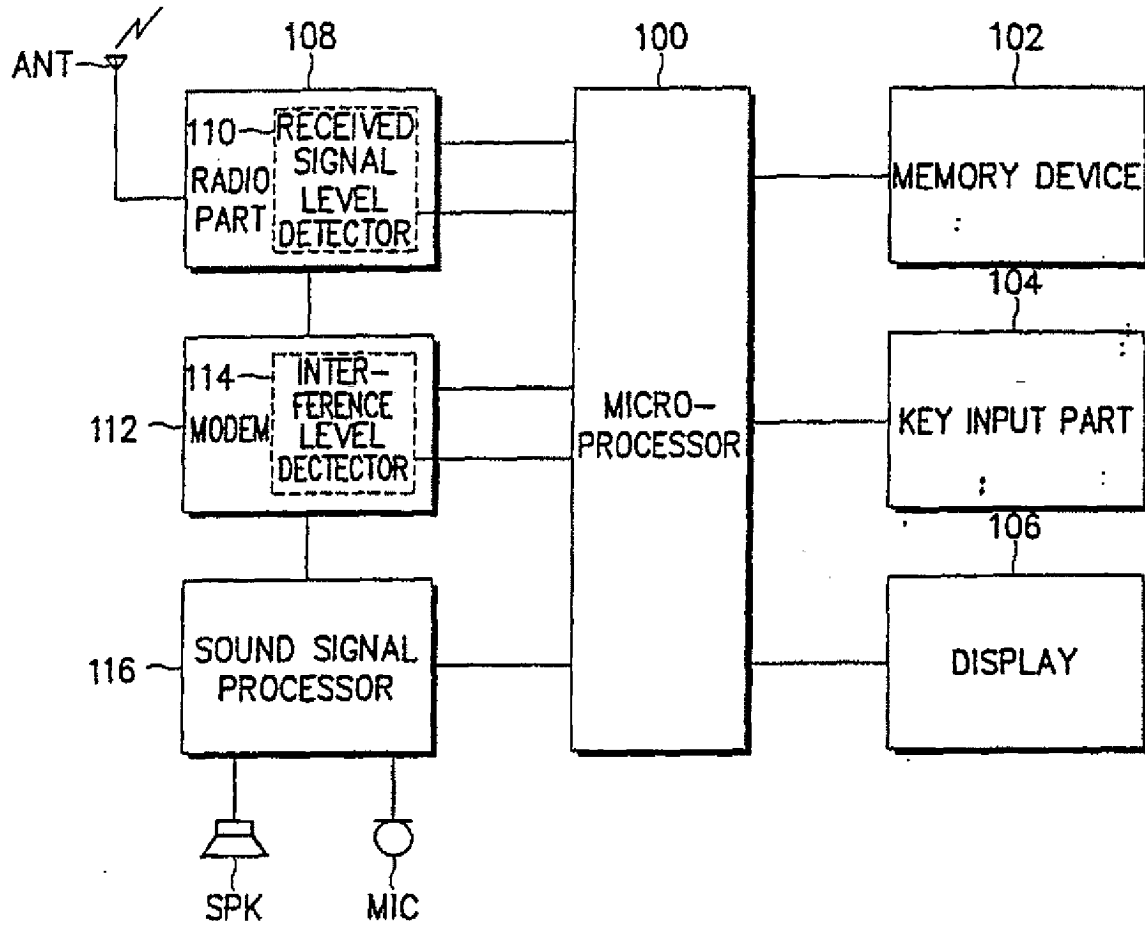


FIG. 4

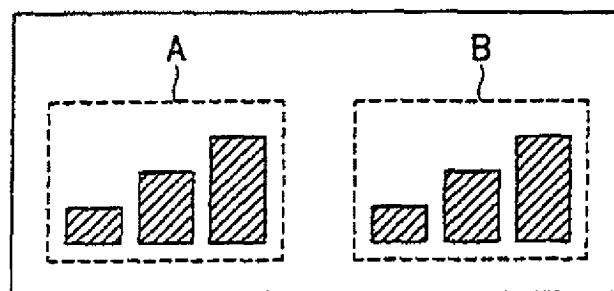


FIG. 5

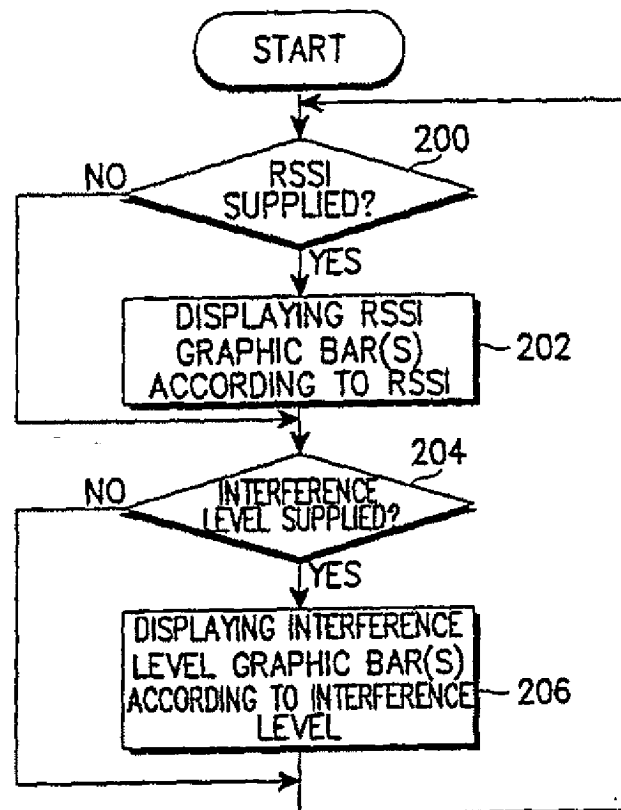


FIG. 6

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TERMINAL AND METHOD FOR DISPLAYING THE PROBABILITY OF  
ATTAINING SUCCESSFUL COMMUNICATION IN A MOBILE RADIO  
TELEPHONE

5 Background of the Invention

The present invention relates to a mobile radio terminal,  
and more particularly to a device for displaying the  
probability of attaining successful communication in a  
10 mobile radio terminal such as CDMA (Code Division  
Multiple Access) mobile radio telephone.

Conventionally, a mobile radio terminal displays a  
probability of attaining successful communication by  
15 continuously detecting the Received Signal Strength  
Indicator (RSSI) of a signal received from the base  
station. For example, such probability may be represented  
by three graphic bars which may be displayed on the LCD  
of the mobile radio terminal, as shown in Figs. 1 to 3.  
20 If the detected RSSI is strong, indicating the highest  
probability of successful communication, all three bars  
which are respectively small, medium and large are  
displayed as shown in Fig. 3. Likewise, if the detected  
RSSI is medium or weak, respectively indicating  
25 relatively less or the least probability, the small and  
medium bars are displayed as shown in Fig. 2, or only the  
small bar as shown in Fig. 1.

However, the probability of attaining successful  
30 communication does not simply depend on the RSSI. If  
there is wave interference from adjacent channels or base  
stations, the probability is decreased even with the  
strong RSSI. For this reason, there has been proposed to

take into consideration the data error rate of the received signal when displaying the probability. For example, if the detected RSSI is strong with a high error rate, the probability is displayed low. However, this  
5 does not correctly inform the user of the causes contributing to the probability of attaining successful communication.

#### Summary of the Invention

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It is an object of the present invention to provide a device and method for displaying the probability of attaining successful communication of a mobile radio terminal. Preferably such a device and method correctly  
15 informs the user of the causes influencing the probability.

According to an aspect of the present invention, a mobile radio terminal comprises: an interference level detector  
20 for detecting a data error rate of a received signal; and a display arranged to display information concerning said data error rate.

The mobile radio terminal may further comprise means for  
25 generating a received signal interference level in accordance with the data error rate. The display may be arranged to display information representing the received signal interference level.

30 The mobile radio terminal may further comprise a detector for detecting a level of a parameter affecting a probability of attaining successful communication in a mobile radio telephone (other than the data error rate).

The display may be further arranged to display information concerning said parameter.

5 The parameter may be a received signal strength indicator (RSSI) of the received signal.

10 The mobile radio terminal may further comprise a microprocessor for receiving the data error rate and/or the parameter, and for supplying the information concerning the data error rate and/or the information concerning the parameter to the display.

15 The present invention also provides a method for displaying a probability of attaining successful communication in a mobile radiophone, comprising the steps of: detecting a data error rate of a received signal; and displaying information concerning said data error rate.

20 The method may further comprise: generating a received signal interference level in accordance with the data error rate; and displaying information representing the received signal interference level.

25 The method may further comprise: detecting a level of a parameter affecting a probability of attaining successful communication in a mobile radio telephone (other than the data error rate); and displaying information concerning said parameter.

30

The parameter may be a received signal strength indicator (RSSI) of the received signal.



A microprocessor may perform the steps of: receiving the data error rate and/or the parameter; and supplying the information concerning the data error rate and/or the information concerning the parameter to the display.

5

The information may comprise an indication of low, medium or high probability of attaining successful communication.

10 The information may comprise an indication of probability of attaining successful communication, using a variable indicator such as a digit, or an icon, or a graph or similar means.

15 Information concerning the data error rate and information concerning the parameter may be simultaneously displayed.

#### Brief Description of the Drawings

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The objects, characteristics and scope of the present invention will be more fully understood with reference to the following description of certain embodiments, given by way of examples only, with reference to the

25 accompanying drawings, in which:

Figs. 1 to 3 are schematic diagrams illustrating graphic bars displayed on the LCD of a conventional mobile radio terminal, which represent the probabilities of attaining  
30 successful communication according to prior art;

Fig. 4 is a block diagram illustrating the structure of a mobile radio telephone according to an aspect of the

present invention;

Fig. 5 is a schematic diagram for illustrating graphic bars displayed on the LCD of a mobile radio telephone according to an aspect of the present invention; and

Fig. 6 is a flow chart for illustrating a process of displaying the probability of attaining successful communication of a mobile radio telephone according to an aspect of the present invention.

#### Detailed Description of the Drawings

A mobile radio telephone according to an embodiment of the present invention preferably incorporates a device which enables the user to correctly perceive causes contributing to a probability of attaining successful communication. According to an aspect of the present invention, this may be achieved by separately displaying the RSSI and an interference level of a received signal.

Referring to Fig. 4 the functions of the mobile radio telephone may be controlled by a microprocessor 100. The microprocessor indicates on display 106 the RSSI of a received signal supplied from a received signal level detector 110. According to an aspect of the present invention, the microprocessor also, or alternatively, indicates on the display 106 the received signal interference level of the received signal supplied from an interference level detector 114. A memory device 102 includes a ROM for storing the control program and other essential information and a RAM for storing temporary data generated during the operation of the microprocessor

100. A key input part 104 consisting of a plurality of keys serves to generate key data to be applied to the microprocessor 100.

5 The RSSI and/or interference level of a received signal are each displayed on a display 106 under the control of the microprocessor 100, for example, as shown in Fig. 5. Graphic bars A, representing the RSSI, are referred to as RSSI graphic bars, and graphic bars B, representing  
10 the received signal interference level are referred to as interference level graphic bars. By analogy with the graphic bars of Figs. 1-3, described above, a small bar displayed alone represents a weak RSSI or a high interference level, the small and medium bars displayed  
15 together represent a medium RSSI or interference level, and all three bars displayed together represent a strong RSSI or a low interference level.

Overall, each set of graphic bars may preferably be  
20 arranged to show a small bar to indicate a low probability of attaining successful communication; a small bar and a medium bar to indicate a medium probability of attaining successful communications; and  
25 all three bars to indicate a high probability of attaining successful communication.

A radio part 108 converts a baseband signal received through a modem 112 into a radio frequency signal to be transmitted through a radio channel to a base station.  
30 Alternatively, a radio frequency signal received through antenna ANT is converted into a baseband signal which is then transferred to the modem 112.

The radio part 108 includes the received signal level detector 110 for detecting the RSSI of a received signal, and supplying the detected RSSI to the microprocessor 100.

5

The modem 112 converts a microphone sound signal from a sound signal processor 116 into a radio frequency signal to be supplied to the radio part 108, or converts a radio frequency signal from the radio part 108 into a baseband  
10 signal to be supplied to sound signal processor 116 for supply to a speaker SPK.

In particular, the modem 112 includes the interference level detector 114, which detects a data error rate of  
15 the radio frequency signal from the radio part 108, to generate the received signal interference level, which it supplies to the microprocessor 100.

The sound signal processor 116 is connected with a  
20 speaker SPK and microphone MIC to transfer the sound signal from MIC to the modem 112 or the signal from the modem 112 to SPK.

The process of displaying the RSSI and interference level  
25 of a received signal will now be more specifically described, with reference to Fig. 6.

Microprocessor 100 determines in step 200 whether the received signal level detector 110 supplies the RSSI of a  
30 received signal. If the microprocessor 100 receives the information concerning the RSSI, it goes to step 202 to display the RSSI graphic bars, or otherwise to step 204.

In step 202, the small RSSI graphic bar is displayed alone on the display 106 if the RSSI is weak, the small and medium RSSI bars are displayed together if the RSSI is medium, and all the three RSSI bars are displayed if  
5 RSSI is strong.

Subsequently, in step 204, the microprocessor determines whether the interference level detector 114 supplies the interference level of the received signal. If the  
10 microprocessor 100 receives information concerning the interference level, it goes to step 206 to display the interference level graphic bars.

Similarly to the process of step 202 the small  
15 interference level graphic bar is displayed alone on the display 106 if the interference level is high, to signify a reduced probability of successful communication. The small and medium interference level bars are displayed together if the interference level is medium, to signify  
20 a medium probability of successful communication. All three interference bars are displayed if the interference level is low, to signify a high probability of successful communication.

25 Thereafter, the process returns to step 200.

Thus, the invention provides a device and method for displaying a level of interference in mobile radio communications, on a portable mobile radio terminal. The  
30 invention also provides a mobile radio telephone which enables a user to be correctly informed of the probability of attaining successful communication together with the causes contributing to the probability.

While the present invention has been described with reference to certain specific embodiments, by way of illustrative examples, it will be appreciated by those skilled in the art that various changes and modifications may be made without departing the scope of the present invention. In particular, the device and method of the present invention may be adapted to provide for the display of parameters other than RSSI and/or interference level. Two or more parameters may be displayed; Alternatively, only one parameter, such as interference level, may be displayed.

The parameters may be displayed concurrently, on adjacent bar graphs. The parameters may alternatively be displayed one at a time, in turn, on a single bar graph. The bar graph(s) may have more, or fewer, than three bars, and be controlled appropriately, by analogy with the three-bar bar graphs described.

Display devices other than bar graphs may be used: a numerical representation may be used, a single line of varying length, or a symbol of varying dimension or intensity. In particular, a variable indication method may be used for displaying the probabilities of attaining successful communication, using a digit, or an icon, or a graph or similar means. Display means other than LCD may be used. For example, each bar graph may be replaced by a tri-colour LED, each colour representing one of the three states shown in Figs. 1-3.

## CLAIMS:

1. A mobile radio terminal comprising:
  - 5 - an interference level detector for detecting a data error rate of a received signal; and
  - a display arranged to display information concerning said data error rate.
- 10 2. A mobile radio terminal according to claim 1, further comprising means for generating a received signal interference level in accordance with the data error rate, wherein the display is arranged to display  
15 information representing the received signal interference level.
3. A mobile radio terminal according to any preceding claim, further comprising a detector for detecting a  
20 level of a parameter, other than the data error rate, affecting a probability of attaining successful communication in a mobile radio telephone; and  
wherein the display is further arranged to display information concerning said parameter.
- 25 4. A mobile radio terminal according to claim 3 wherein the parameter is a received signal strength indicator (RSSI) of the received signal.
- 30 5. A mobile radio terminal according to any preceding claim wherein the information comprises an indication of low, medium or high probability of attaining successful communication.

6. A mobile radio terminal according to any of claims 1-4 wherein the information comprises an indication of probability of attaining successful communication, using  
5 a variable indicator such as a digit, or an icon, or a graph or similar means.

7. A mobile radio terminal according to any of claims 3-6 wherein the information concerning the data error  
10 rate and the information concerning the parameter are simultaneously displayed.

8. A mobile radio terminal according to any preceding claim, further comprising a microprocessor for receiving  
15 the data error rate and/or the parameter, and for supplying the information concerning the data error rate and/or the information concerning the parameter to the display.

20 9. A method for displaying a probability of attaining successful communication in a mobile radiophone, comprising the steps of:

- detecting a data error rate of a received signal;  
and
- 25 - displaying information concerning said data error rate.

10. A method according to claim 9 further comprising:  
- generating a received signal interference level in  
30 accordance with the data error rate; and  
- displaying information representing the received signal interference level.



11. A method according to claim 9 or claim 10, further comprising:

- detecting a level of a parameter, other than the data error rate, affecting a probability of attaining successful communication in a mobile radio telephone; and
- displaying information concerning said parameter.

12. A method according to claim 11 wherein the parameter is a received signal strength indicator (RSSI) of the received signal.

13. A method according to any of claims 9-12 wherein the information comprises an indication of low, medium or high probability of attaining successful communication.

14. A method according to any of claims 9-12 wherein the information comprises an indication of probability of attaining successful communication, using a variable indicator such as a digit, or an icon, or a graph or similar means.

15. A method according to any of claims 11-14 wherein the information concerning the data error rate and the information concerning the parameter are simultaneously displayed.

16. A method according to any of claims 9-15 wherein a microprocessor performs the steps of:

- receiving the data error rate and/or the parameter; and
- supplying the information concerning the data error rate and/or the information concerning the parameter to the display.

17. A mobile radio terminal substantially as described with reference to and/or as illustrated in Figs. 4-6 of the accompanying drawings.

5

18. A method substantially as described with reference to and/or as illustrated in Figs. 4-6 of the accompanying drawings.



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Application No: GB 9917043.3  
Claims searched: 1-16

Examiner: Anita Keogh  
Date of search: 21 January 2000

**Patents Act 1977**  
**Search Report under Section 17**

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK CI (Ed.R): H4L (LESF, LETXX, LEUF, LFMA, LFMX)

Int CI (Ed.7): H04B (17/00), H04L (1/20), H04M (1/72), H04Q (7/34)

Other: Online: WPI, JAPIO, EPODOC

**Documents considered to be relevant:**

Category	Identity of document and relevant passage		Relevant to claims
X	EP 0565229 A2	(IBM) see abstract, figure 5, column 3 lines 29-36, column 4, lines 28-42, column 8, line 37 to column 9, line 8	1-16
X, P, &	US 5802039	(OBAYASHI et al.) see abstract, figures 4, 5, 16, 19, column 2, lines 13-28, 36-39, column 3, lines 49-67, column 4, lines 27-60, column 8, lines 23-39	1-16
X	US 5640684	(KONOSU et al.) see abstract and figures 8, 10	1-16
X	US 5539803	(BHAT et al.) see abstract, column 9, lines 10-30	1-6, 8-14, 16
X	JP 100163950 A	(KOKUSAI ELECTRIC CO LTD) see JAPIO abstract and figures 1-7	1, 9 at least
X	JP 090135203 A	(NIPPON T&T) see JAPIO abstract	1, 9 at least
X, &	JP 060311078 A	(TOSHIBA) see equivalent US 5802039	1-16
X	JP 050061789 A	(NEC) see JAPIO abstract	1, 9 at least

X Document indicating lack of novelty or inventive step  
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